

5.5/19

abs max

abs min

$$f(x) = x^3 - 3x - 2 \quad ; \quad (-\infty, \infty)$$

$$\Rightarrow f'(x) = 3x^2 - 3 = 3(x-1)(x+1)$$

$$f' = 0 \Rightarrow x = 1, -1 \quad (\text{critical \#s})$$

$\Rightarrow f'$  undefined impossible  
end behavior

$$\lim_{x \rightarrow \infty} x^3 - 3x - 2 = +\infty$$

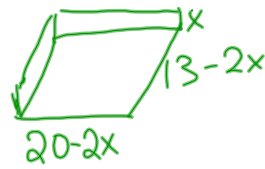
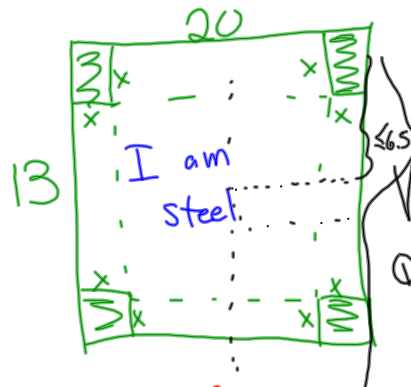
$$\lim_{x \rightarrow -\infty} x^3 - 3x - 2 = -\infty$$

## 5.6 Applied Maximum or Minimum [aka optimization]

Key Ideas:

rel max	}	endpoints or end behavior
abs max		
rel min		1st derivative - zero - undefined
abs min		

a problem



$$V = x(13-2x)(20-2x)$$

①: maximize Volume

Find  $\frac{dV}{dx}$ .  $V = x(4x^2 - 66x + 260)$

$$V = 4x^3 - 66x^2 + 260x$$

$$\frac{dV}{dx} = 12x^2 - 132x + 260 = 4(3x^2 - 33x + 65)$$

Endpoints or end behavior

0 as one endpoint (although  $V$  would be 0)

6.5 as other endpt ( " )



$$0 = 4(3x^2 - 33x + 65)$$

$$3x^2 - 33x + 65$$

$$3 \cdot 65 = 195$$

$$\begin{array}{r} 1 \cdot 195 \\ 3 \cdot 65 \\ 5 \cdot 39 \\ 13 \cdot 15 \end{array}$$

$$\begin{array}{r} + \\ 196 \\ 68 \\ 44 \\ 28 \end{array}$$

$$x = \frac{33 \pm \sqrt{33^2 - 4(3)(65)}}{6}$$

$$x = \frac{33 \pm \sqrt{1089 - 780}}{6}$$

$$x = \frac{33 \pm \sqrt{309}}{6}$$

$$x = \frac{33 \pm 17.578}{6}$$

+ disallowed

$$x = \frac{33 - 17.578}{6} = 2.570 \text{ in}$$

5.6/ 1-35 ODD

$$\begin{aligned}10 &= (x + y) & 0 < x \text{ and } y < 10 \\ & & (0, 10) \\ xy &= f(x) \\ x(10-x) &= f(x) \\ f'(x) &= 10-2x \\ 10-2x &= 0 \\ x &= 5\end{aligned}$$

product = 25

$$\left[ \frac{1}{2}, \frac{3}{2} \right]$$

$$f(x) = (x) + (x^{-1})$$

$$f'(x) = 1 + -1x^{-2}$$

$$-1 = -1x$$

$$1 = \frac{1}{x^2} \quad x = 1, -1$$

$$x^2 = 1$$

$$\left( \frac{1}{2}, 1, \frac{3}{2} \right)$$

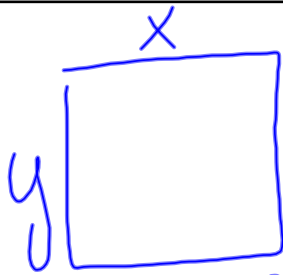
$$x + x^{-1} \frac{1}{x}$$

$$1 + \frac{1}{1} \quad 2$$

$$1 + 2 \quad 2\frac{1}{2}$$

$$\frac{1}{2} \text{ max}$$

$$\frac{1}{2} + \frac{2}{3} \quad \frac{13}{6}$$



$$y = 1500 - \frac{3}{2}x$$
$$y = 750$$

$$6x + 4y = 600$$
$$y = 1500 - \frac{3}{2}x$$

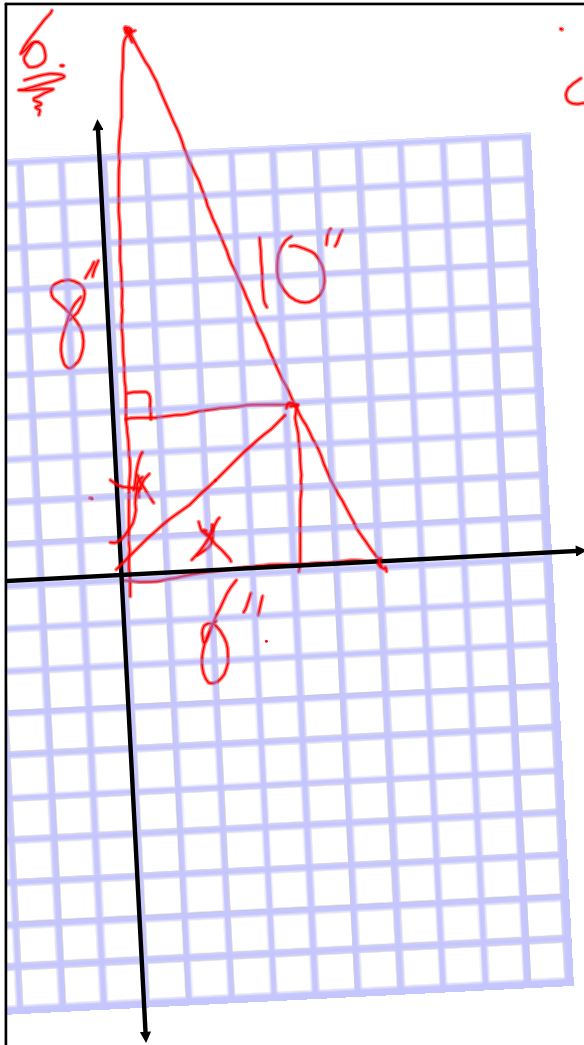
$$x \cdot y = f$$

$$x \cdot (1500 - \frac{3}{2}x) = f$$

$$1500x - \frac{3}{2}x^2$$

$$f' = 1500 - 3x$$

$$x = 500$$



$$a = X \cdot y \cdot 0 - 8 \cdot \frac{-8}{6-0} = \frac{-8}{-6}$$

$$y = \frac{4}{3}x$$

$$(X, y) = P$$

$$\frac{y}{x} = m = \frac{4}{3}$$

$$a = 1 \times y = mx + b$$

$$a = y = \frac{4}{3}x + 8$$

$$a = x \left( \frac{4}{3}x + 8 \right)$$

$$a = \frac{4}{3}x^2 + 8x$$

$$\frac{da}{dx} = \frac{8}{3}x + 8 = 0$$

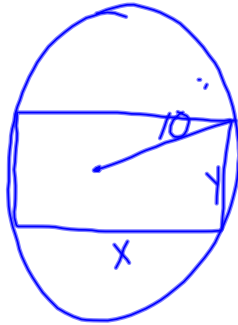
$$-8x = -8 \cdot 3$$

$$x = 3, y = 4, 4 \cdot 3 = 12$$

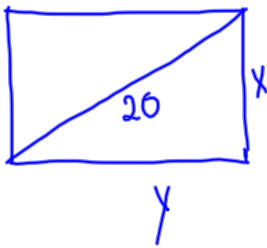
$$\max a = 12$$



9.)



$$A = xy$$



$$A = 20^2 x - x^3$$

$$dA = 20^2 - 2x^2$$

$$\frac{20^2 = 2x^2}{2} \quad 10^2 = x^2$$

$$A = (x) \sqrt{20^2 - x^2}$$

$$20^2 = x^2 + y^2$$

$$\sqrt{20^2 - x^2} = \sqrt{y^2}$$